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THE PRODUCTION OF HYACINTH BULBS

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INTRODUCTION

The common garden hyacinth is a plant of easy culture and production. It can be grown under varied conditions, and its handling for ornamental purposes is simple. It is therefore admirably adapted to a large commercial use.

The multiplication of stock is by artificial means, which has thrown a glamour of mystery about the production, so that few growers have had the temerity to attempt the culture. Production of the crop on a commercial scale also demands a considerable outlay of capital, some equipment, and a wait of four to six years for returns on the investment. These facts, coupled with the inherent risk obtaining in the continued culture of the same individual bulbs over a period of three to five years, make the hyacinth crop one in which only he who has a steadfastness of purpose can afford to engage.

It must be admitted, therefore, that the hyacinth crop has in its production some elements that tend to discourage the grower, but these elements have been greatly magnified in the public mind. Barring the rather simple technical information necessary, the propagation of the hyacinth involves no more difficulties than many other horticultural crops requiring the same length of time for their production. The technicalities involved need worry no grower who has the skill to handle successfully the ordinary cutting bench.

The common garden hyacinth, derived originally from *Hyacinthus orientalis*, a native species rather widely distributed in the Eurasian region, but particularly in the vicinity of Aleppo and Baghdad, has been cultivated for ornament since Grecian times and is one of the most popular of our early spring bulbs. It has a long and interesting history, and its culture is particularly fascinating.

In the first half of the nineteenth century there was a great increase of new varieties. It is said that the Dutch growers of that period enumerated over 2,000 varieties and that some nurserymen regularly offered 300 or more.

The present commercial situation is quite different and decidedly improved. The large growers have weeded out their stocks until only about 100 varieties are offered. This has been a great boon to the consumer, for his task of selection is very much simplified. Some of the largest growers, on the other hand, offer no more than 50 varieties. It is not at all certain but that a careful selection of 50 would serve all purposes and that it would be a decided advantage to both producer and consumer if the number of varieties were kept down to this or even a lower figure.

The group is a simple one, the classification being entirely on the basis of color. The varieties are usually listed as red and rose, blush and white, dark and light blue, yellow, and purple and violet. Most growers offer doubles in a restricted but similar list, while others omit these entirely because they are much less popular and have a tendency to produce green in the flowers, especially when forced, and the stems are too weak to hold up the trusses.

The Dutch hyacinths of to-day have formal, massive inflorescence of large bells, very different from the delicate, lax-flowered Roman hyacinth. Occasionally, however, delicate, graceful forms of what are apparently derivatives of *Hyacinthus orientalis* are found. Some of these are naturalized or seminaturalized in this country. The pink, of which there exist a double and a single form, grown in portions of Tennessee, is a good example. Some of these may have a useful place in our markets when stocks are built up. They are as delicate and graceful as the Roman hyacinth and are perfectly hardy. Their main disadvantage is not forcing any earlier than the ordinary Dutch stocks. Were it not for this characteristic, forms derived from *H. orientalis* could be selected which are just as decorative and delicate as the Roman, and as useful for bouquets and corsages.

The main uses of the hyacinth are for formal bedding and for forcing in pans, flats, and vases in a variety of ways. It is not usually naturalized and is not used as a cut flower as much as in pots or vases with its foliage intact.

There is probably no other bulb which is so universally discarded after flowering as the hyacinth. Yet this is not necessary, for all but the top sizes will function for several years before they split, and a bulb dried off after flowering will blossom again the next year.

There is a great air of mystery about producing the hyacinth bulb. Its artificial production is very different from that of any other bulb. Its culture is supposed to be difficult, its cultural requirements exacting, and its enemies so powerful that it is commonly believed that only the grower who fully understands the mysteries of its culture and handling can succeed in its production.

Twelve years' experience leads the writer to the conviction that there is a large amount of popular fallacy about the difficulties of hyacinth production. The purchaser knows that the plants are simplicity itself when the time comes to bring them to flower under artificial conditions. No more difficulties have been encountered in the experimental production of the bulbs. The methods of production must be learned as of any other crops, but these processes are neither so abstruse nor difficult but that any good grower can master them. Thus far, pests can be dismissed in a few sentences. There are molds and rots that develop in storage. A bacterial rot is induced by the use of raw manures. The nema and the yellows (Wakker's disease) have not appeared in any of our experimental bulbs, although none but commercial stocks have been employed in these cultures. Hyacinth bulbs have been found adaptable to a wide and variable range of conditions. Although there is a great difference in this respect between Puget Sound and Virginia, good hyacinths of a wide range of varieties have been grown in both locations, and none of those tried have been failures.

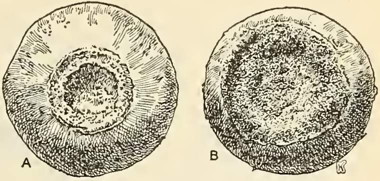

FIGURE 1.—The bases of (A) a normal hyacinth bulb and (B) one ruined by poor drainage

SOILS FOR HYACINTH PRODUCTION

Nearly all writers on the subject insist on quite pure sand for the culture of hyacinths. Experience in this country, however, does not indicate that this is an imperative requirement. There are certain soil conditions that must obtain, and perchance such conditions are most easily met in sandy loams, but their fulfillment is not impossible elsewhere.

The hyacinth requires an abundance of moisture and perfect drainage. Putting the matter another way, the hyacinth should never dry out during the growing season. At the same time there should not only be no stagnant moisture, but the soil should not be so retentive as to approach what is known as sogginess at any time. The water passes readily through a good hyacinth soil. The reaction of a poorly drained soil is a very characteristic one. The base of the bulb and the roots soon fail, and decay once started soon destroys the whole plant. (Fig. 1.)

The investigations of the Bureau of Plant Industry at the Arlington Experiment Farm, Rosslyn, Va., have been conducted mostly but not entirely on a coarse sand. Some of the soil has been quite clayey but it has all been well drained.

The culture at the United States Bellingham Bulb Station, Bellingham, Wash., has been on fine sands and quite fine silts. In all but a few cases a perfect contour has been maintained with deep surface ditches and tile drains every 50 feet. Little difficulty has been encountered in maintaining health and development in these situations. There has been base injury on some occasions, traceable to local lack of drainage on particular plots. (Figs. 1 and 2.)

Should a formula for the culture of hyacinths be required, it might be stated thus: A friable loam which is constantly moist, never soggy, and well aerated during the growing season. The soil should remain friable and loose during the crop period; otherwise the bulbs can not develop properly. Of course these purely mechanical features are more universal in a lean sand, but a soil that is naturally more fertile and of finer texture seems to be by no means barred in the successful production of hyacinth bulbs.

FERTILIZER

Some foreign growers insist on cow manure as a fertilizer for hyacinths. A heavy application in winter followed by a hoed crop which is removed before the bulbs are planted in September is considered good practice. Experience of 10 years in this country does not indicate that manure is an imperative requirement; indeed, less trouble has been experienced in maintaining the health of the stocks when it has not been used. Above all, the experimental work has shown that the use of horse manure is questionable to say the least. In one year nearly 10 per cent of the stocks in some varieties were lost from a bacterial soft rot when an application of old sweetpotato-hotbed manure which had lain in the weather from late spring to midwinter was used. Another year even more rotting occurred when a heavy application of stable manure the season before planting was made.

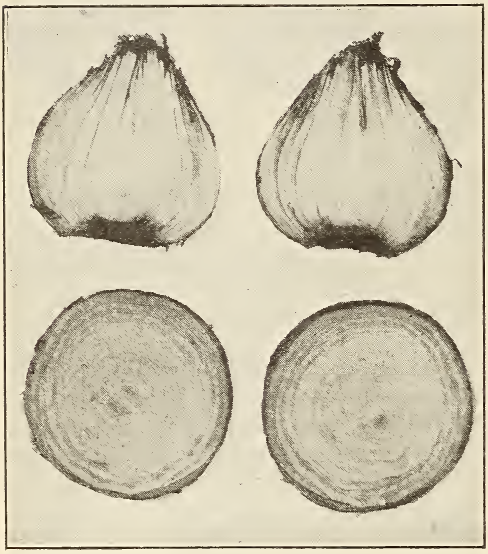

FIGURE 2.—Vertical and horizontal sections of hyacinth bulbs ruined by poor drainage. The bases are completely rotted out, but the centers of the bulbs are still perfect

During the last few years the hyacinth stocks have been grown mostly with no manure, and it is believed with just as good growth and certainly with perfectly healthy bulbs. The soil has been well supplied with plant food, however.

It may be that the hyacinth crop in this country can be profitably charged each year with double the land actually planted in order to get the soil into proper condition to grow the bulbs by a cover-cropping system for enrichment. In a region like Virginia to the eastern Carolinas, two or three cover crops may be turned under in a fallow year following a bulb crop. After the bulbs are dug in June, a crop of cowpeas may be planted and then put under, followed immediately by a crop of rye, and this again by cowpeas, which can be put under a month or more before the planting of the bulbs the next year. Such treatment, supplemented by a high-grade fertilizer at the rate of 1,000 to 1,200 pounds to the acre at planting time, should produce good hyacinths. Even with this treatment, 150 to 200 pounds of sulphate of ammonia in the spring as the plants come through the ground seems to be warranted.

At the Bellingham Bulb Station planting is done on rotted 3-year or 4-year sod on land that is inclined to be heavy and refractory. The last crop of hay may be put under about the middle of June. The land is then kept fallow, and rye is sown in August. The following June this is put under, and the bulbs are planted in August. This heavy application of green manure may be supplemented by 1,000 to 1,200 pounds of chemical fertilizer. Sometimes bone meal may be used, especially when a residue is desirable for the following crop. There seems to be no question that a surface application of 150 to 200 pounds of sulphate of ammonia is decidedly advantageous here also, this to be applied broadcast in early spring as the plants come up but before the leaves expand. Liming seems to be beneficial in both situations.

It is believed that some such maintenance of fertility as described herein will produce this crop, which has such a heavy fertilizer requirement, without the use of any animal manures and with resulting healthier stocks. Such practices have produced good experimental bulbs which have given perfect satisfaction when subjected to commercial forcing.

PLANTING

The planting of hyacinth bulbs, once they have been sized and the ground prepared, does not differ from that of various other classes of bulbs; nor does it seem imperative that any particular form or system of planting should be practiced. Different methods, however, have their own advantages, and the grower can choose that which seems to him to suit his needs best.

The bed method of planting (fig. 3) is a concentrated, intensive one which has been found most advantageous for experimental work and is universally employed in the Netherlands. There is no reason why the bulbs will not grow as well if planted in rows, other conditions being equal. It is questionable whether wide-row planting with horse cultivation can be made entirely satisfactory for the reason that losses from mechanical injury resulting from tools and animals are likely to be too serious. Mulching is prohibitive in wide-row planting.

Bed planting requires that the land be laid off carefully and marked off accurately. (Fig. 4.) The soil is then excavated from the first bed to a depth of about 4 inches. If fertilizer is to be applied it is put in the bottom of the excavation. When this is done it is a good plan to cultivate well with a wheel hoe to incorporate the fertilizer thoroughly with the soil. The bottom of the excavation is then made smooth with a rake, and commonly a marker is run through to place the rows accurately 6 inches apart across the 3-foot bed.

The bulbs are then set in rows on the marks thus made. Large bulbs (18 cm. or larger in circumference) or propagated bulbs may be set 7 or even 5 to the row; miniatures (13 to 15 cm.) may be planted 9 to the row; smaller bulbs (9 to 12 cm.) will have room enough if planted 11 to a 3-foot row; those 6 to 8 cm. in circumference may be planted about 14 or 15 to the row. There will be two sizes smaller than this. One of them is strewn along without placement about 21 to the row; while the smallest bulbs are strewn 35 to the row, or about 1 to the inch. Often, if the land is fertile, 50 of the smallest size may be planted to a 3-foot row. Bulbs more than 10 cm. in circumference are placed upright; all others are uniformly distributed along the row but without definite placement. The practice varies, although the larger bulbs are always set carefully by hand in an upright position. The bulbs are covered with the soil excavated

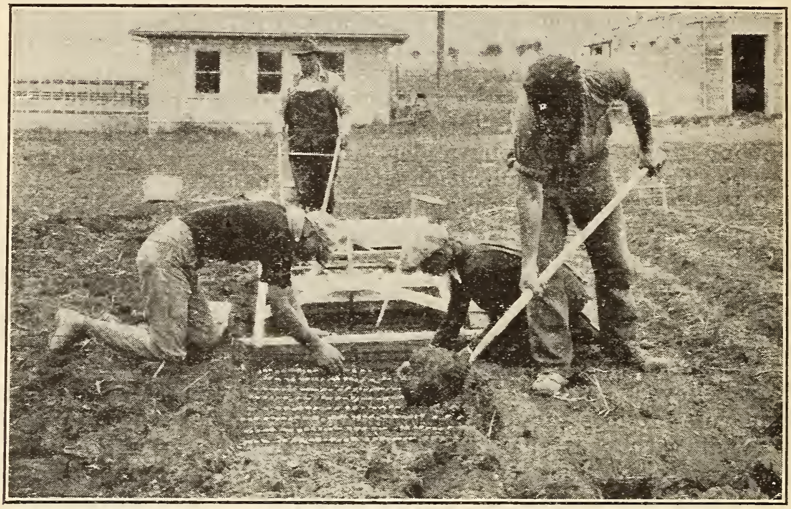

FIGURE 3.—Planting small hyacinth bulbs in the conventional Dutch bed

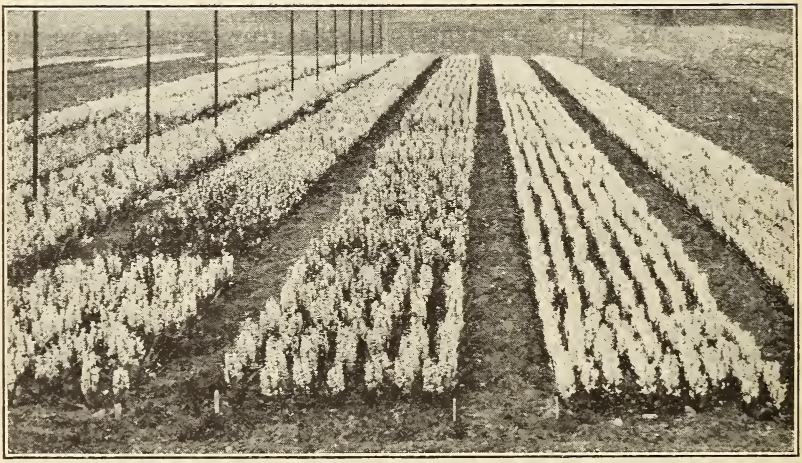

FIGURE 4.—Hyacinth plantings at the Arlington Experiment Farm, Rosslyn, Va. Those shown here are the second propagation from imported bulbs

from the next bed, which is fertilized, raked down, marked, and planted in the same way. This process is repeated across the entire plot. The proper handling of the soil in a bed planting requires experience and skill. A regular plan is followed, and each shovelful goes to a definite place in the bed being covered.

The row system of planting may take several forms, but the writer considers the furrow method the most simple, economical, and in many ways preferable. There does not seem to be any good reason why hyacinth bulbs, as well as tulips and daffodils, can not be planted (and dug) with a plow although no attempt has been made to do this in the writer's experiments, for the reason that the number of varieties was large and the quantity of each grown was comparatively small.

In the furrow or plow method of planting in rows, a furrow is opened in the usual way at the desired depth. A hand rake may or may not be employed to mark a crease in the furrow slice at the proper height. This may be done without guide or along a taut line, depending on how accurate and uniform the planter wishes his operation to be. The distance of the rows apart may vary, for hand cultivation, from 10 to 16 inches. The most economical spacing, it is believed, is about 12 inches. The bulbs are set by hand in single lines much as described for the bed system of planting, but may be placed closer on account of the wider interrow space.

Whatever method of planting is used, care should be employed. A little extra effort to get uniformity of alignment and depth will well repay not only in appearance but in actual betterment and uniformity of the crop.

BETWEEN PLANTING AND DIGGING

As with most bulbs handled on an annual basis, the cultivation should be included in the main in the preparation of the land before planting. The bed method presupposes little or no cultivation other than that necessary to remove weeds. In row planting the same principle should largely govern. Land that is so packed or baked that stirring is required during the growing season either needs better preparation or is unsuitable for hyacinth culture.

In the bed method of planting but little cultivation is practicable. The paths between the beds may be loosened with a wheel hoe to counteract the effect of trampling. It is possible to scratch a little to a depth of about 2 inches between the rows after the plants are up and before the leaves are fully expanded. Before the plants come up the surface of the beds is best kept clean with a garden or scuffle hoe used from the paths. The beds should not be walked on.

Herein lies one of the difficulties of the narrow-row method of planting. The position of the rows is not known until the plants come up; consequently, in any operation that takes place on the planting in the fall and early winter, it must be walked on. At this time weeds must be kept down. This is usually done with a wheel hoe run across the rows, but the work should be done carefully to cause as little injury as possible from trampling.

A row planting in furrows, as described, with every fifth row left unplanted for a path is practicable. If the position of the paths is marked, all work on the planting in the fall can be performed from them without setting foot over the bulbs. This plan has some decided advantages. It might then be practicable to economize space by reducing the row width to 10 inches.

DIGGING

The digging of hyacinth bulbs planted in beds is accomplished with short-handled spades by workmen on their knees. (Fig. 5.) Skill and experience are required in this operation, and it is seldom that the workmen succeed until they have become accustomed to the work.

Commonly, unless digging is promptly done, surface indications of the position of the bulbs may be entirely wanting, especially if weeds have necessitated previous hoeing. In such event the workman is guided entirely by his knowledge of the planting scheme.

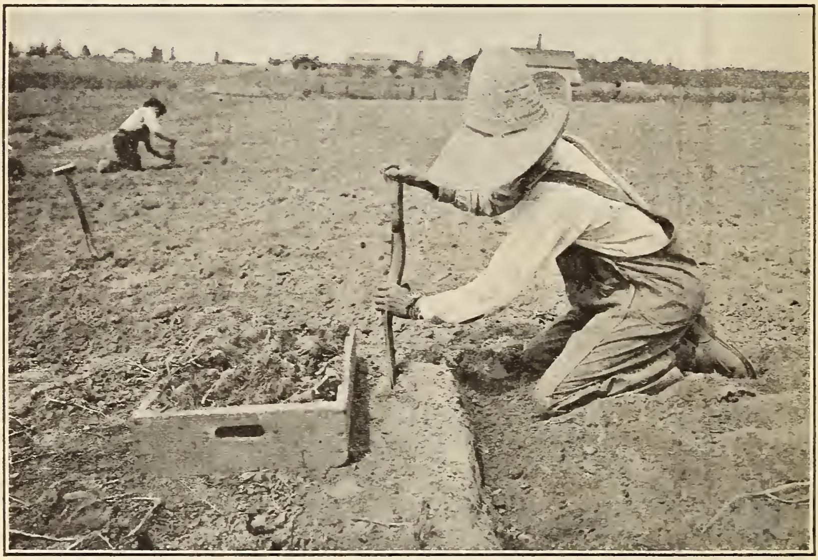

FIGURE 5.—Method of digging bulbs planted in beds

The beds are of definite width, and the bulbs are in rows 6 inches apart; consequently, a row having been found and taken out, the position of the next row is evident.

In loose, sandy soil a flat trowel may be used in digging. The experimental work herein described has not been done on soils light enough to permit the use of the trowel. A light spade with a D handle cut down to about 24 inches over all has been the most suitable tool.

The simplest way to dig hyacinth bulbs is with a plow. This presupposes planting by the use of the same implement. If the bulbs are planted in rows 10 to 15 inches apart the furrow slice can be made to include the row by running the point just inside and the share just under the row. The bulbs are then thrown bottom up on top of the slice with their roots, which are more or less alive, in plain view. The experience of the writer with both tulips and daffodils has led to the conviction that the use of the plow causes less injury to the bulbs than hand digging. When the plow is adjusted, and the crew has gotten the knack of the work, the operation is a very satisfactory one with a large variety of bulbs.

BULBS IN THE FIELD AFTER DIGGING

At the Bellingham Bulb Station it has been the practice with all but the small hyacinth bulbs to place them in windrows in the paths as dug, where they often remain for a day or two. They are then brushed lightly with a broom to remove the adhering soil just before being placed in lug boxes to be taken into the bulb house.

Firmer bulbs, like tulips and daffodils, will withstand screening over a wire mesh to remove the soil; but it is not a good practice to be so rough with hyacinths. The wire screens are too likely to bruise them. The screen-bottom boxes are used as containers in digging the small sizes, but the bulbs are not shaken in them. The contents are simply stirred gently by hand, thus removing the soil sufficiently.

In the Virginia region it is not considered wise to expose the bulbs at all unless the sky is overcast. Care is taken even to cover the baskets with weeds or other débris during the short time they remain in the field. With a greater percentage of overcast sky, and the likelihood of a hazy or smoky atmosphere at digging time on Puget Sound, the danger of injury from sunning is very much reduced.

REMOVAL TO STORAGE

Hyacinth bulbs are easily bruised; consequently care should be exercised in handling them at all times, but more especially when freshly dug. Splint or willow baskets make suitable containers and are much more desirable than either wooden or iron lug boxes or baskets, for the reason that they are better aerated and less likely to cause mechanical injury.

Hyacinth bulbs should always be placed (never thrown) in the containers. A drop of even a foot is liable to cause some bruising when the bulbs are green. Pouring from one container to another deeper one should not allow a vertical drop, but the receiving vessel should be tilted so that the bulbs roll down the side.

The bulbs should remain in the containers as short a time as possible and never overnight. Carelessness here is apt to start a sloughing of the outer coats. Cheap imported hyacinths often show this condition. When once a rotting of this character has taken place, the coats are likely to be "steppy" ever after, even when the bulbs are brought back to a sound condition by thorough aeration and subsequent culture. In hot weather, remaining in the containers overnight is almost certain to start softening of the coats.

STORAGE

Bulbs of any size should be poured out on trays or shelves in a well-aerated situation as soon as they arrive in the bulb storage house. They should be in thin layers, preferably not over 4 inches deep, and their surface dried in as short a time as possible. A good draft of air over the bulbs for the first week or 10 days will insure better keeping quality.

In the experimental work at the Arlington Experiment Farm the bulbs have been stored in a poorly-ventilated brick half basement, where it has not been possible to dry them quickly enough even with the aid of an electric fan. In order to insure thorough and prompt drying, the trays have been stacked outside in the shade of the building and trees for two or three days until the coats were well desiccated, and they were then put on the racks inside. After the moisture from the outside of the bulbs was thoroughly removed, the storage conditions were satisfactory provided the bulbs were not put in too thick layers. An ideal bulb storage for hyacinths in the vicinity of Washington, D. C., would be a cool place with good ventilation.

If the storage period is a long one, as is likely in a hot region, the matter of light should be considered. Excessive exposure will cause the bulbs to turn green, which is not desirable. Hyacinths should always be stored in the driest portion of the bulb house. They do not suffer from continued airiness as do some other bulbs, for their desiccation takes place more slowly. The danger is from underdrying rather than from overdrying.

Greater care should be exercised with smaller sizes, such as the previous summer's propagation, for they are particularly liable to injury from improper drying. If the weather is wet when the propagation is dug there is likely to be more or less putrid material from the decay of the old coats. Again, a mass of small bulbs is always less perfectly aerated than the same bulk of large ones, making it imperative that particular attention be given to the propagation after the first digging.

Small bulbs also require closer attention after surface drying is completed. In ordinary storage conditions for a reasonable period of time there is little danger that large hyacinth bulbs (13 cm. or more in circumference) will dry out too much. The case is different with small bulbs. It is easy to overdry or even ruin them by too great desiccation. The smaller the bulblets, the greater the danger.

One should not lose sight of the fact that the danger of spoilage in all bulbs is greatest immediately after digging. After thorough drying in storage for a few weeks the stocks can withstand being piled up two or three and often four or five times as thick, while abrasion from screening and other rough handling is not nearly so likely to occur. However, hyacinth-bulb tissues are delicate, and the bulbs should never be roughly handled.

The storage period for hyacinths should not really be looked upon as a dormant one, for profound changes are taking place in the bulbs during the entire period. The flower spike, which is not visible when the bulbs are dug, may be seen in about three weeks; while at planting time if that be as late as October, the tip of the spike may be pushing out of the top of the bulb and each floret well advanced toward maturity. (Fig. 6.) In other words, growth and development are taking place in storage, which make it all the more imperative that the conditions for storage be suitable for the evolution of the flower spike.

PREPARATION FOR PLANTING

Preparing hyacinth bulbs for planting is a simple matter and entails but little labor. Tulips must be handled individually to break up the clumps, and daffodils require much the same treatment. Hyacinths, on the other hand, require little more than sizing, which can be accomplished for medium quantities by the use of the ordinary nesting sieves. (Fig. 7.)

At times the young propagated bulbs are held together lightly by the old coats which have dried down and inclosed a number of bulbs in and between them. Such clumps are easily broken between the fingers on the sieves, and the bulbs pass through to their proper position or size. Commonly, four or five sizes of planting stock are necessary. In the smallest size there will be a great deal of dirt and débris. The cleaning of these bulbs is accomplished by the use of a grain-fanning mill slightly rearranged and padded so as not to bruise the bulbs as they fall through the draft from one level to another.

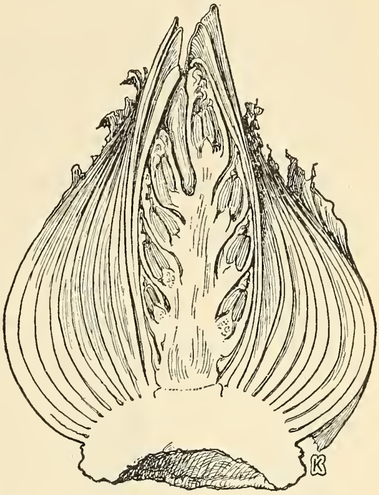
FIGURE 6.—A mature hyacinth bulb cut open to show the well-developed flower spike at tne time of planting

The nesting sieves are of the ordinary hoop construction with the bottoms preferably of rawhide or laminated wood, but often of metal perforated with different sized holes from 3 to 23 cm. in circumference. They are stock articles in bulb countries and may be imported, but in this country they must be made to order. The sieves may be nested in a carrier attached to the ceiling by three ropes or wires, or they may be inserted in the carrier of a shaker such as that illustrated in Figure 7.

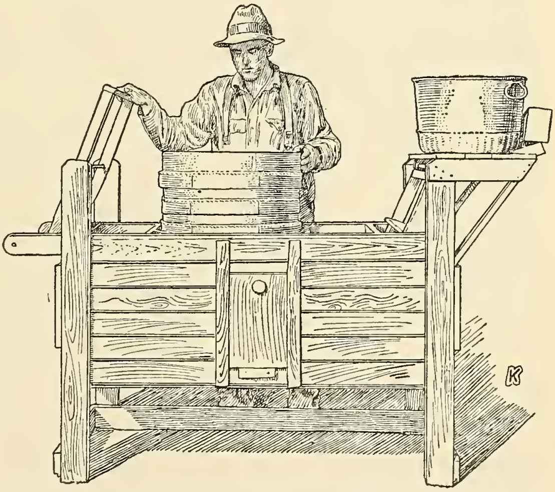
FIGURE 7.—A machine for sizing bulbs. Three sieves, making four sizes, are being employed

The sizing is actually quite complicated, in that it varies from year to year with the development of the progenies. Usually, however, four sieves which separate five sizes are sufficient for planting stock. If a first-year progeny from scored bulbs is being prepared one might use 5, 7, 9, and 11 cm. sieves, making five sizes, or possibly only four sizes, as there may be few or no 11-cm. bulbs. The succeeding years the sizers would need to be stepped up if the same number of categories were prepared.

In the sizing of bulbs, judgment based on experience plays an important part. The selection of the proper sieves for accomplishing a certain task is soon learned and often saves a great deal of labor. As an illustration: In certain types of soils there may be a lot of small clods or gravel which will be sieved into the smaller size. This often occurs at the Bellingham Bulb Station. Usually running the smaller size over another screen of 1/4-inch or 3/8-inch wire will remove the small clods or gravel sufficiently and easily.

ARTIFICIAL PROPAGATION

For reasons that will become apparent hereafter, the Dutch hyacinth is propagated almost entirely by technical and very artificial means, discovered accidentally many years ago, it is said. The underlying principles are neither new nor essentially different from those employed in the propagation of scores of other perennials; only the details of the application are unique. These methods must be learned, but after they have been comprehended, any intelligent person can succeed with them.

SCOOPING

The reproduction of hyacinths by scooping is in reality a propagation by cuttings conducted by artificial means for the acceleration of growth through the agency of heat and moisture.

In all reproduction by cuttings the new growth is induced to take place from a cut surface, and the character and characteristics of the cut are of as great importance in the propagation of the hyacinth as in the propagation of woody plants. This should be kept in mind constantly as this art is practiced. The principles of ordinary cutting reproduction are as truly applicable in the scooping process of multiplying hyacinth stocks as in the propagation of hardwoods. The main factor of originality here lies in the fact that the cuttings consist of the entire number of elements of a scaly bulb, propagated in position under artificial conditions, it is true, but not different in principle from conditions obtaining in the bottom-heated sand bench. In both cases the cut surface must be healed and vegetation induced. In the ordinary hardwood cutting this is first evidenced by root growth, but in the hyacinth by the production of a complete miniature plant on the healed surface of the vascular strands of the succulent scales of the old or mother bulbs.

This method of artificial propagation results in a complete destruction of the old bulb. It gets its name from the fact that the basal plate is cut out in concave fashion, the cut being parallel and close to its upper curved surface, the plate being discarded, and the remainder of the bulb made up entirely of scales used in the propagation.

The operation of scooping out the base of the bulb is a simple one when once the knack is learned. It is accomplished with a single stroke of a curved-bladed scalpel, with a rounded-bowled spoon with edges sharpened, and less perfectly with a small-bladed jackknife. (Fig. 8.) Any of these instruments should be of good tool steel which will hold an edge well. They must be sharpened frequently, for the cut is likely to bring the edge in contact with considerable grit.

Even with a sharp instrument more or less trouble is experienced because of the difficulty of cutting through the dry, tough outer coats. Often the workman is obliged to run his thumb nail along the cutting edge of the tool to remove the old coats which accumulate over it; however, he soon learns to use a sort of diagonal or sliding cut instead of a vertical push through the tissues.

In making the cut, whatever instrument is used, the aim must be to remove the basal plate completely and thus expose the cut surfaces of all the bulb scales. If this is not done—that is, if portions of the plate are left attached—there is an interference with the future development of bulblets, and a propagation will occur which simulates that from scored bulbs in which the unremoved portions of the base give rise to adventitious axillary buds that develop into bulblets like those in the next process.

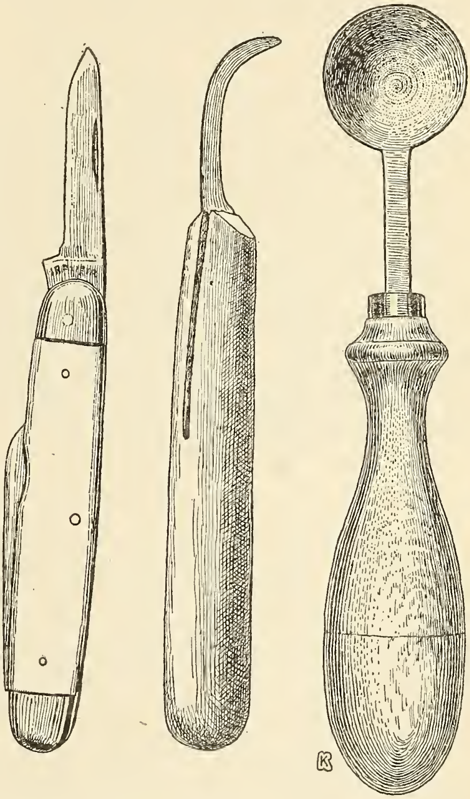

FIGURE 8.—Cutting tools used in the propagation of hyacinths

SCORING

The process of multiplying stocks of the hyacinth by scoring differs very radically from the previous one, not only in manipulation but in principle as well. The scales of the bulb are morphologically modified leaf bases inserted on the basal plate, which in turn is morphologically the stem. All development of bulblets in this process takes place from the stem between the scales, or, as the botanist would put it, from the leaf axils.

The plant organ, in most plants situated in the leaf axil, is a bud. No buds are visible in these leaf or scale axils in the hyacinth, but they may be induced to develop; consequently they are spoken of as adventitious buds. These buds develop on the substance of the old bulb from the basal plate and become bulblets capable of leading an independent existence and of growing into full-sized hyacinths.

The scoring process consists in making usually three cuts across the base of the bulb, dividing the circle as nearly as may be into six equal parts, each cut going through the growing point and extending nearly halfway through the bulb, or at least close to the bulge or greatest diameter. This operation requires no special tools. The large blade of an ordinary jackknife answers the purpose admirably if it will keep a good edge. Here again the cut is made with a push or a pull of the knife rather than a straight shove perpendicular to the blade. There are two main directions to be given here: (1) The cut should be perpendicular to the basal plate of the bulb so as to allow perfect freedom for the cut to gap open when callusing; (2) each cut should be deep enough to go through and extend a little beyond the growing point of the bulb.

CORING

The method of propagation known as coring is analogous to scoring. It consists in the entire removal of the growing point with a minimum of mutilation of the basal plate. An apple corer or similar instrument may be thrust vertically through the center of the bulb, thus removing a core three-eighths to one-half inch in diameter. Such a destruction of the growing point forces the development of adventitious buds between the bulb scales as in the scoring method.

The reproduction from this method of cutting results in a progeny very comparable to that of the scored bulb. The writer's experience with the method is limited to two years, but it seems to have one decided advantage in that the cut surface is fully exposed, facilitating callusing and reducing the tendency to rot. Satisfactory behavior has resulted from burying the cored bulbs in sand for two weeks previous to incubation.

SANITARY PRECAUTIONS WHILE CUTTING

In cutting hyacinths by any of the foregoing methods of propagation there is constant opportunity for spreading infection from one bulb to another on the knife. Precaution against this, however, is necessary only when there is infection in some of the stock. On the other hand, molds and other saprophytic organisms which may flourish on the cut surfaces are always present. For this reason it is desirable that the blade be disinfected frequently, whether disease is actually detected or not.

The disinfection can be easily effected by dipping the blade of the cutting instrument for a few moments into alcohol or a dilute carbolic-acid solution which is kept handy for that purpose in a glass or a porcelain cup. A good plan is to have two cutting instruments, keeping one in the solution constantly, and changing them frequently. It is advisable to disinfect the knife every 25 to 30 bulbs in any event, and also after cutting any bulb that may appear in the least questionable.

When it is necessary to disinfect the knife frequently, especially after the use of a corrosive or strong disinfectant, the injury done to the first cut by the fluid clinging to the knife is considerable. It is therefore a good plan to dip the knife into water after disinfecting, before using it again.

When bulbs are scored, none of the cut surfaces can be examined; but the scooping process exposes the cut ends of all scales in one slightly curved surface which can be easily and quickly viewed. It is remarkable how expert one soon becomes in detecting discolorations and other abnormal or diseased conditions as the bulbs pass through the hands at the rate of three to five a minute. All bulbs that look suspicious can be culled out. Such an advantage is of considerable moment where diseases are present in the stock, but scooping was not of great importance in the writer's experiments because no serious diseases were encountered.

CALLUSING THE CUT

The period immediately following the cutting of the bulbs is a critical one in the history of a hyacinth propagation whether a scooping or a scoring process is employed. Most careful attention is required, for upon a proper handling at this time depends much of the after success. Bad treatment then can not be corrected later.

As will be readily realized, when three deep cuts are made across the base of the bulb in the scoring process, the two cut surfaces come back together as the knife is withdrawn, leaving them tightly appressed and in the best possible condition to induce rotting, especially in hot weather. What is needed at this time is to exclude the air, reduce the humidity, and cause the gashes to gap open so that the injured surfaces may heal. This seems to be best accomplished not in the open air as with the scooped cut, but buried in sand as in the callusing of most cut surfaces in plant tissues. In this case, however, instead of a moist covering as is commonly employed in callusing hardwood and softwood cuttings, the sand should be quite dry. Much moisture from any source at this time is fatal, for molds then develop and rotting instead of callusing occurs.

The actual handling of the bulbs at this time may be subject to great variation, provided always that the above conditions are kept in mind and met. In the writer's experiments the bulbs as soon as cut have been handled in a variety of ways with equal success. In late years, due to convenience, the scored bulbs have been put in dry sand on the benches in the greenhouse. Owing to the likelihood of intense heat under glass in the month of June near Washington, D. C., the handling has been rather critical at times; but even with a day temperature of 100° F. or more, good success has been the rule when the sand was perfectly air dry and the bulbs covered to the depth of an inch or more. But any considerable amount of moisture from drip or otherwise has always induced the development of molds which have been fatal to callusing and caused partial or complete rotting of the bulbs in a few days. The damage may be beyond repair in even as short a time as two days.

It is not necessary to house the bulbs at all at this time. A common practice is to bury them, as soon as scored, in dry soil in the open ground. (Fig. 9.) This is really the most practicable method where large propagations are conducted. A covering of an inch or so of dry soil is sufficient. No attention is necessary as long as the soil remains dry, but should a rain occur within about 10 days it may be necessary to lift the bulbs to dry them off so as to prevent molding and consequent decay.

These two examples will serve to illustrate the diversity of methods that may be employed in the handling of the bulbs immediately after they are scored. Variations of these treatments will suggest themselves to the grower, such as callusing in sand under a porch of a dwelling, under a shed roof, or in coldframes that may have the sash put on to shed rain. Such methods have been employed with success, the main factor being dry earth around the bulbs during the callusing period. When buried under an inch of sand there is little likelihood that the bulbs will dry out too much before the cut surfaces are healed.

While such methods are practicable, no real hyacinth grower can afford to go into the business of producing commercial stocks on a makeshift basis. It is cheaper and much safer to get equipped to do the work under better control; however, there may be circumstances when makeshifts are necessary.

Two weeks is usually time enough to callus the surface of the scored bulbs. They are then taken out of the dry sand or other earth and put on trays to be incubated. During this brief 2-week period wonderful changes take place. When first scored the cuts are not visible except under close inspection, but at the end of the period the surfaces have not only callused but have spread apart, leaving wide triangular gashes in the bases of the bulbs (fig. 10) extending through the basal plate and exposing the cut scale bases as far up as the knife went.

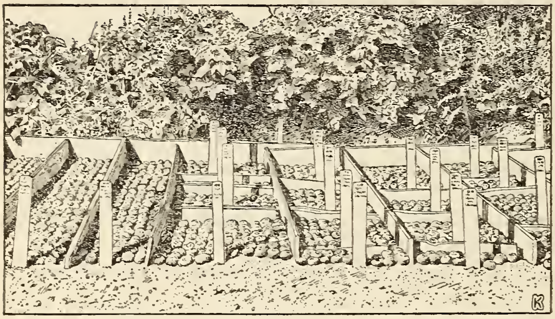

FIGURE 9.—Scored hyacinth bulbs ready for callusing under sand out of doors at the Bellingham Bulb Station, Bellingham, Wash.

The scooped bulbs are handled quite differently from the scored ones, for they are allowed to callus in the open air with no covering. For convenience during recent years this has been accomplished in the packing shed, or well elevated from the floor under the benches of a greenhouse where there was no drip. Subdued light or no light is to be preferred.

The bulbs as soon as scooped may have their cut surface treated with some disinfectant or drying agent. Air-slaked lime diluted with equal parts of fine sand and pulverized charcoal, and equal parts of charcoal and flowers of sulphur have been used satisfactorily. Commercial dry Bordeaux mixture with an equal part of fine sand has given good results. While all these agents have been used along with checks of no treatment at all, it is felt that experience thus far does not justify the recommendation of any one treatment over another. The efficacy of any treatment has not been apparent, for the greater part of the time the untreated surfaces have remained as clean, callused as quickly, and reproduced as well as any of the treated surfaces. The feeling is that these agencies may have a slight beneficial effect in drying the surface and retarding the development of organisms of putrefaction, but have no efficacy when conditions for the healing of the cut surfaces are right. No disinfectant can be used on the scored bulbs.

The application of the drying agent or disinfectant is best accomplished by dipping the scooped end of the bulb into a mass of the powder in a shallow dish in such a way as to cover the scooped surface evenly and completely. Care is necessary in this process to keep the powder in whatever form clean, for it is easy to contaminate it with flakes of the outer skins of the bulbs. These particles, even only one-eighth of an inch in area, stuck to the cut surface, are detrimental, as they prevent drying and consequently induce decay. It is well, therefore, to provide a piece of fine-wire screen by means of which the dust may be cleaned as often as necessary.

If the weather is damp and the scooped surface is not healing well, the bulbs should be placed in the incubating chamber immediately, and the temperature run up to about 80° F. without humidity, to prevent the development of molds and to induce healing.

SUPPORTS FOR THE BULBS

To handle the bulbs properly and conveniently during the incubation period it is necessary to provide containers or supports that afford the maximum of air circulation about them. Supports that meet all requirements may be in the form of trays 2 by 3 feet, the frames of which are made of 1 by 1 inch lumber and the bottoms of 1-inch mesh chicken wire. Trays with solid bottoms are not suitable; in the first place, there should be free circulation of air all around the bulb, and, in the second place, the weight of the bulb on a solid surface for three months would tend to cause rotting and interfere with the growth of the bulblets.

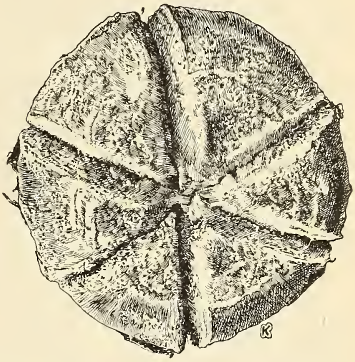

FIGURE 10.—A scored hyacinth bulb at the time it was taken out of the sand two weeks after being cut. It is now ready to be incubated

POSITION OF THE BULBS ON THE SUPPORTS

The scooped bulbs are preferably placed on trays as soon as cut, and the scored ones as soon as they come out of the sand after callusing. It is preferable (mainly for the purpose of easy inspection) to have the scooped bulbs placed bottom up on the trays until the cut surfaces are thoroughly callused. They are then placed with the cut surface down; that is, the bulb is set upright in its normal position on the wire support. When the scored bulbs come out of the sand they go on the screen wire in an upright position also, and remain in this position through the entire incubation period.

In the handling of hyacinths in these propagations the bulbs must be treated individually, for no mass method can be tolerated. Every bulb must be definitely placed on the support, and under no condition should they be placed two deep. It is even better if they do not touch one another, although this is neither imperative nor practicable.

INCUBATION

TEMPERATURES FOR INCUBATION

A wide latitude in temperatures is permissible in the propagation of hyacinth bulbs. The optimum of 70° to 90° F. should not be deviated from. The callusing may be done at a lower temperature and the maximum may never reach 90° F., but with lower temperature the process of development of bulblets will be retarded, and if constantly low the development will have to be made up in the soil during the following years.

The object of the artificial incubation is to accelerate development to a rapid pace under observation and to control high heat and humidity in order to transfer as large a part of the substance of the scales as possible into bulblets before late fall, when the bulbs must be planted out. If this is slowed up by lower temperatures the young progeny simply gets a poorer start.

While the temperature is given as 70° to 90° F., and variations between these extremes are permissible during the entire period, it is during the latter part of the incubation after the complete callusing and starting of bulblet formation that the higher temperatures are mostly to be employed. It is better to start at a temperature of 70° F. and run it up gradually to 85° to 90° F., the temperature which should be maintained constantly during the last two months of the period.

HUMIDITY IN INCUBATION

As heretofore stated, the main consideration immediately after the bulbs have been cut is to dry the cut surfaces rapidly. Until callusing has taken place the bulbs should be kept on the dry side, but desiccation should not be carried to an extreme; that is, the wilting of the bulbs should not take place, for this causes loss of vitality which it may not be possible to overcome later.

It has been found that during the first week or 10 days especially the daily fluctuation of temperature and relative humidity at both Bellingham, Wash., and Washington, D. C., often make it somewhat difficult to callus properly the scooped bulbs in the open air. The condition of the bulbs during the day may be satisfactory, but the cut surfaces seem to be somewhat hygroscopic and to absorb a detrimental quantity of moisture during the night which sometimes prevents their drying off before 10 o'clock or later. This condition of the atmosphere must be watched for and corrected. It is commonly necessary to put the bulbs in the incubation chamber promptly after they have been scooped, to apply a little heat to bring the temperature up to about 75° F. during the night to prevent the development of molds, and to subject them to regular atmospheric conditions during the day.

If artificial heat is applied early, before callusing of the scooped surface has taken place, care must be exercised that it be not overdone. The effort must be to let the cut surface heal and at the same time not to dry the bulbs enough to weaken them. The turgidity or firmness of the bulbs should change but little until the developing bulblets absorb the substance of the scales.

When callusing is complete the regular incubation begins and the temperature should be gradually increased, but as this occurs the moisture supply becomes more important. Constant effort must now be directed toward keeping the atmosphere sufficiently moist so that the bulbs do not dry out too much. In the last half of the season, when danger from molds does not obtain, the atmosphere should be close to saturation.

CHARACTER AND MANAGEMENT OF INCUBATION CHAMBER

The chamber in which hyacinths are incubated may be any room or inclosure with heat, light, and ventilation under control. For large operations a room is necessary, but for a small number of bulbs any boxed-in space that meets the above requirements may serve. Very successful propagations of a small number of bulbs have been seen in an ordinary egg incubator that was artificially heated only during the night and solar heated during the day.

The investigations of the Bureau of Plant Industry have been conducted under a variety of conditions. The first propagations were made at Bellingham, Wash., in a small frame building provided with racks for holding 100 or more trays, as described elsewhere. The building was piped for hot-water heating like an ordinary greenhouse but with less radiation. Success during this time seemed to depend upon one main factor, namely, the proper control of the humidity.

Later, when funds were reduced, it became necessary to curtail expenses and to get along on a makeshift basis, which was not without its advantages, for it compelled the use of methods that otherwise would not have been tried. At this time the investigations were transferred to the Arlington Experiment Farm where the temperatures were high enough under the benches of an ordinary greenhouse for fairly good propagation without artificial heat, or at least with a minimum of it. On Puget Sound heat must be maintained continuously from the first of July to the middle of October; in Washington, D. C., it can be dispensed with, with fair results, except during the last three or four weeks of the incubation period, and then only a little is necessary.

In the eastern section a very much reduced propagation has been conducted, usually no more than 1,000 to 2,000 bulbs. The work was done under the benches in a greenhouse for the first three years with no artificial heat, but later a homemade chrome-nickel coil was introduced to increase the temperature electrically toward the end of the period. The space under the benches was inclosed by a curtain of two thicknesses of ordinary burlap tacked to the sides. The bulbs were handled in this space on wire-bottomed trays, as described elsewhere. It was found that the temperature in this chamber fluctuated most of the time between 70° and 90° F. during July, August, and the first half of September, but after that it fell too low for the best development of the bulblets. Ventilation in such a chamber takes care of itself fairly well, for the porosity and the raising and lowering of the burlap during inspection give sufficient change of air.

The humidity is maintained by wetting the walks and burlap, allowing as much water as is necessary to run to the ground under the benches. In case too much water is applied the curtains are raised to give more ventilation for a few hours.

Hyacinths have been propagated by incubation in sand under a porch of a dwelling in Washington, D. C., with no attention during the entire period; in boxes of sand in the warm attic of the bulb house in Bellingham, Wash.; and on shelves in the cellar of a dwelling in Washington, D. C. In all of these cases the propagation was all that could be desired except that the bulbs were small at the end of the season because of too low a temperature and too dry an atmosphere.

The most interesting experiment was, as is commonly the case, due to an accident. About two dozen small bulbs, 14 cm. in size, were propagated in June, 1921. After being callused well they were placed on a wire tray and set over a pan of water in an unfinished attic of a frame building. Owing to the serious illness of the writer, the bulbs were entirely undisturbed until October, 1922. The old bulbs were well dried out, but there was a small propagation of bulbs in fairly good condition but undersized and with their outer coats very hard and dry. They were planted in flats in the greenhouse, where they grew well the first season, and then planted in the open. They are now in good condition and close to the ultimate in hyacinth development.

Some of the propagations detailed in the foregoing paragraphs are crude, but it is believed they are important in that they signify that set rules and definite expensive structures are not necessary in the propagation of these stocks. Certain conditions are necessary for best results, but there may be various ways of supplying them. The grower will use his ingenuity in adopting the means at hand to serve him in his propagation.

In the handling of the stocks in propagation there are three main factors to keep under control:

(1) The light should be at least subdued. Most good propagating is now done in darkness. Light develops green coloring matter (chlorophyll) in the bulblets, which is not desirable.

(2) Temperatures should be high to induce rapid growth in the bulblets. Propagation will take place at 20° less temperature than advocated, but it will be slow, and the bulblets will be small at the close of the incubation period. Some growers score the bulbs and plant in the field immediately, with good results, provided the soil is dry enough for the first two or three weeks; but here again the development is slow, owing mainly to the low temperatures. The temperature should be high enough to force all the substance possible from the scales of the old bulb into the bulblets during incubation.

(3) Moisture should be liberally supplied to the atmosphere in the incubation chamber to make up for the loss by evaporation under the high heat. Too dry an atmosphere causes withering and weakening of the old bulbs. This must be guarded against by keeping up the turgidity (firmness).

While the propagations may be conducted fairly satisfactorily on a makeshift basis, the high value and the large quantity of the stocks employed demand that the essential features of incubation be under complete control. In other words, the serious operator should have a chamber where heat, light, moisture, and ventilation are capable of perfect regulation.

THE INCUBATION PERIOD

The endeavor should be to propagate the hyacinth bulbs as early as possible. The actual date will vary with the locality, and in the locality from year to year as the season varies, for it is dependent upon the date at which the bulbs are dug. In the Puget Sound region it is scarcely possible to get the digging over and the bulbs cut before July 10. In the region of Washington, D. C., this work can often be finished by June 20.

The earlier the incubation can begin the better, for the time is none too long to bring the bulblets to full development. The propagation can not be conducted beyond about the middle of October. There is no fixed date at which the bulbs should be set out, but the middle of October is the latest on Puget Sound. It has been necessary to plant about the middle of September in Virginia because the bulblets start to form roots at about this time. If the planting is delayed beyond the first half of October on Puget Sound the ground is likely to be too wet and cold to transfer the young bulblets from their warm quarters in the incubation chamber.

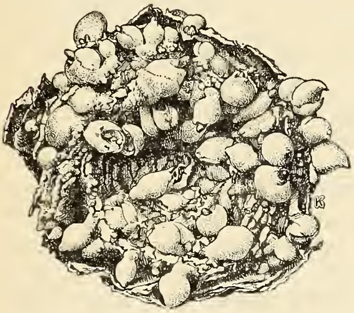

FIGURE 11.—A scooped hyacinth bulb after two and one-half to three months in the warm, moist atmosphere of the propagating chamber. It is now ready to be planted in the field

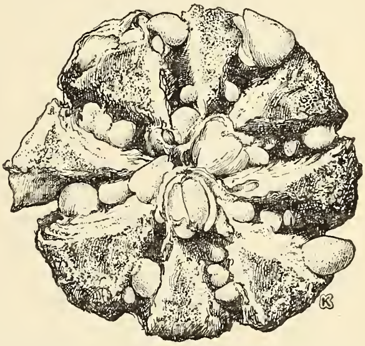

FIGURE 12.—A scored hyacinth bulb ready to be planted after a propagation period of three months in artificial heat

It is evident, therefore, that the best results are not obtainable when bulbs are imported from abroad and propagated the same season, for they are not likely to arrive before mid-September. The most practicable thing is to buy second-sized bulbs, grow them one year, and propagate the next. However, if the stock is in good condition time may be saved by propagating immediately upon arrival of the bulbs as late as the middle of September. In such a case the cut bulbs are little more than callused before they are planted out and will make little or no top growth the next season for reasons indicated under "Growth the first year" (p. 23).

The criterion for the discontinuance of artificial forcing of the bulbs in the incubation chamber and their planting in the field is the development of roots. (Figs. 11 and 12.) This takes place some time between two and one-half and three months ordinarily. When the roots begin to push vigorously the bulbs should be moved to the field without delay.

BULBS SUITABLE FOR PROPAGATION

Hyacinth bulbs suitable for propagation should be the strongest, healthiest stock that it is possible to obtain. Their size may vary a great deal, but those that have reached maturity or close to the point at which they begin to divide naturally will have the greater amount of substance to put into the bulblets and will give on the whole the best results in the propagation.

While this is obviously true, rather satisfactory results were obtained one year from the propagation of 14-cm. 2-year-old scored bulbs of L'Innocence. Similar stocks of Grand Maitre have behaved fully as well, but the number of bulblets or their size from small bulbs will not equal those of larger ones under the comparable conditions of propagation.

A bulb of any shape is suitable for scoring if it is not so far divided that it falls apart. With scooping, however, the case is very different, for this process requires an almost perfect bulb to hold together. Therefore, old bulbs that have become somewhat split may be scored, but propagation by scooping must take place before the bulb gets too old.

COMPARISON OF SCOOPED AND SCORED PROGENIES

There are two main distinctions in the bulbs produced by scooping and by scoring. One relates to the date of maturity, and the other to the uniformity of the product.

The progeny resulting from a scooped propagation takes four to five years to come to maturity, while the scored progeny will reach the same stage of development one year earlier. This in general may be taken as the average time required, but the period is variable, as there may be a difference of one or two years in the time taken for bulbs to reach full size in the same progeny even under the best of propagation and cultural conditions; that is, it takes one to two years longer for the smallest bulbs to reach 18 cm. than it does for the largest.

The two methods of propagation result in progenies that are fundamentally different in origin, as previously described on pages 12–14. In the scooped progeny the bulblets produced should be much more numerous. Fifty would be a very fair average, while 30 would be a good average for the scored progeny of a first-size bulb. The main advantage of scooping over scoring, however, is in the uniformity of the progeny. The bulblets are more symmetrical and more nearly of a size, and these relationships continue throughout the development to maturity under proper culture. Since uniformity of bulb makes for uniformity of blossom in pot and bed, the importance of this characteristic is not to be overlooked, and it is for this reason mainly that the scooped progeny is looked upon with greater favor than the other. While the bulblets in the scored progeny vary greatly in shape the first season, they round off later and are perfectly symmetrical at maturity; but even then it is not possible to select as uniform a lot of bulbs from them as from the scooped propagation.

The number of bulblets resulting from scored bulbs depends a great deal on the way the bulbs are handled. The high heat and consequently rapid forced development in incubation results in a larger number of bulblets than a cooler method of handling.

It is perfectly possible to score the bulbs and plant them immediately where they are to grow the next season, provided the first two weeks are reasonably dry. This kind of handling, however, results in a comparatively small progeny of larger bulbs. Often many of them will blossom the first year, and a large percentage will reach miniature size the second year.

Some experiments have given a reproduction of no more than 10 bulblets to a 16-cm. bulb when scored and planted in the field immediately. The same bulbs, when artificially propagated, gave twice as many but smaller progeny.

The two methods of propagation also result in very different flowering during the years of development of the bulbs. The scored progeny, if well handled, may give one or more small flower spikes to each mother bulb the first year, namely, in the old matrix of the mother bulb the spring following the incubation. There are no flowers from a scooped propagation the first year, and often none the second. Of course these features are influenced very decidedly by the perfection of the propagation. Much depends on the degree to which the incubation is carried. If the temperature and other incubation factors have been such as to allow the all but complete transference of the substance of the scales into bulblets they are much farther advanced, will be larger, and consequently flower earlier and more profusely.

GROWTH THE FIRST YEAR

The hyacinth is a wonderfully adaptable bulb in propagation. If conditions are such that only a partial development takes place, due to shortness of the incubation period or failure to keep up the temperature in the incubation chamber, development will continue in the beds after the bulbs are planted, but with resulting poorer growth. Normally, with a good propagation the beds the first season should be covered with "grass" (fig. 13), a profuse growth of narrow leaves in large clumps from each mother bulb planted. In other words, each developed bulblet should throw up one or two narrow leaves. These come up through the matrix of the old bulb at the normal season for hyacinth plants to appear aboveground in the spring. This grasslike growth is directly proportional to the completeness of the propagation before the mother bulbs were set out in mid-October.

When the bulblets are not sufficiently developed during incubation they will continue their development as the soil warms up the next spring, but the growth, being largely at the expense of the mother bulb, will simulate that of the incubation chamber, with little or sometimes no leafage. Consequently, the success of a propagation can be judged by the grasslike growth on the beds the first season. When this sort of imperfect propagation occurs there is not only no top growth but also little root development. Therefore a propagation that has not been carried far enough for the individual bulblets to take hold of the ground by the formation of roots as soon as the mother bulbs are planted in the fall is much more likely to receive winter injury.

So far as the writer is aware, such delayed propagation has really but one disadvantage. The bulblets seem to be just as strong and healthy as those developed in record time, but a large part of a season is lost. When no top growth occurs the first year the bulblets are little or no larger at the first digging time in June than they should have been the previous October when planted in the field. This, of course, is of great importance, for the extra year of culture adds from one-third to one-fifth to the cost of production, which is a very serious handicap. However, there may be circumstances when the grower can with advantage deliberately head into a delayed propagation of this kind through the necessity of saving stock which is on the verge of splitting, delay in arrival of bulbs, or some other untoward circumstance. The excellence of a propagation which produced little or no top growth the first year has often been a surprise.

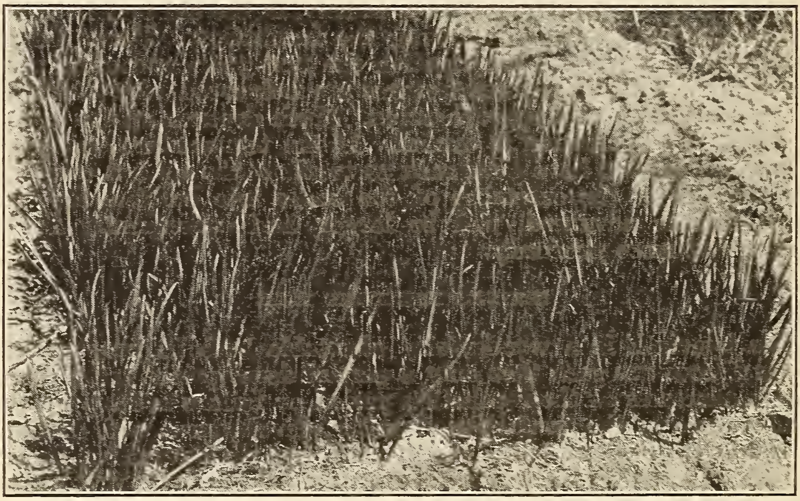

FIGURE 13.—Top growth the first year of a hyacinth propagation

THE FIRST DIGGING OF A PROPAGATION

The digging of propagated bulbs the first year does not differ from the digging of hyacinth bulbs in general, but there are a few precautions which the grower should keep in mind in order to save labor later on. It is important that the stocks be not dug too early the first season. If the development has been carried to the limit in the incubation chamber, the young plants will die down normally and be ready to dig as early or a little earlier than 2-year-old and 3-year-old bulbs. The guide to the time of digging the first season, however, should not be the yellowing of the tops so much as the disintegration of the scales of the old bulb. Digging should not take place until the substance of the old bulb is so used up that the bulblets fall away from one another clean when dug. If dug too early the partially used scales must be pulled off the young bulb, a process not only entailing a great deal of unnecessary labor but depriving the bulbs of much substance besides.

The saving of time here is considerable. As an illustration: One propagation of hyacinths in these experiments, improperly dug, cost 30 days' time for one man in getting them ready to plant when 2 days should have sufficed had the stocks been left undug about two weeks longer, and with benefit to the bulbs in spite of the fact that leaving the hyacinths in wet ground after maturity is not a good practice.

NATURAL PROPAGATION

BULB PROPAGATION

From some points of view the hyacinth propagates naturally in a very satisfactory manner like that of the daffodil by the division of the old bulb. In this natural propagation, however, there are two quite dissimilar cleavages in the bulbs. One results from a true splitting up of the bulb into two or more large ones which are more or less angular in outline, or more often flattened on one side and rounded on the other; the other results from injury or erosion of the edges of the basal plate in such a way as to induce a propagation of a ring or crescent of small flat bulbs around the base of the old one.

This is a perfectly logical and legitimate method of reproduction to depend upon for increasing stock of the Dutch hyacinth; indeed, it is the method used in the propagation of the Roman hyacinth in southern France, and business conducted on this basis is remunerative and satisfactory.

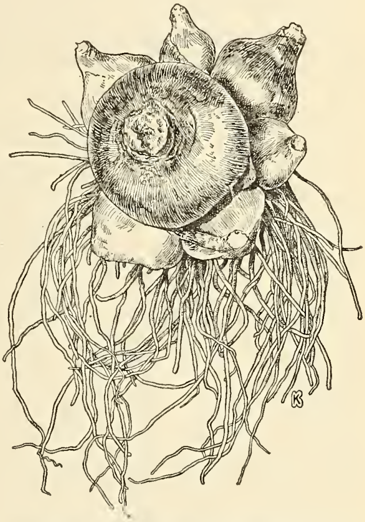

FIGURE 14.—Natural propagation in an old variety of hyacinth grown commonly in Tennessee

There is a great deal of difference in the way different varieties react after they have reached full size. Some cleave into two, about equal-sized, flat-sided bulbs, both of which blossom satisfactorily the next season; others have a tendency to split into many small bulbs which must be grown a year or two to reach even a miniature size. Possibly the most desirable is the one that gives a ring or a crescent of flat bulbs around its basal plate, leaving a symmetrical center which gives a normal large spike of flowers. (Fig. 14.) Such a division can be utilized satisfactorily in propagation. However, the bulbs produced from such a division are not so uniform, and there is the disadvantage arising from the employment of the same bulbs too long. This is obviated in the artificial propagation.

NATURAL AND ARTIFICIAL PROPAGATION COMPARED

Natural propagation has some disadvantages, the chief of which is a lack of uniformity in the progeny. One of the assets of the Dutch hyacinth for bedding and forcing is its formality and uniformity. To attain this similarity, amounting closely to identity through thousands of individuals in blossom, the bulbs to start with must possess similar form and substance.

Of course, the naturally propagated stock may be closely sized, attaining an approximate similarity, but this can never produce the result that is attained in starting uniform bulblets 3 or 4 cm. in size and growing them together in equality for three or four years. It is the ability to produce so many individuals quite similar in form and performance that makes the Dutch method of artificial propagation of the hyacinth so popular and advantageous to both producer and purchaser.

Another disadvantage of natural propagation is the uncertainty of the time element. The time of maturity of the artificial progeny can be quite accurately estimated, and the grower therefore knows from the start what to count on.

Another important factor in favor of artificial propagation is its economic advantage in the quantity of mature bulbs it is necessary to use for the maintenance of stocks. Natural propagation requires that a very large planting of mature stock, which mostly could be sold on the plan of artificial propagation, be used from year to year in order to get a propagation to maintain a planting.

The saving in labor by artificial propagation can be better understood by a hypothetical illustration. Suppose a grower has on hand 112,000 mature hyacinth bulbs and plans to continue in the business. If he depends on natural propagation these 112,000 bulbs planted back will occupy an acre of ground and may have to be grown for two years or more to assure a reproduction of, say, five bulbs each, and the mother bulbs will deteriorate very decidedly. This small propagation will have to be grown two years more to become merchantable, and the mothers also be put back. This entails a big investment in land, labor, and stock on hand which is not only less valuable on account of natural deterioration, but on account of its age the losses in handling are likely to be greatly multiplied by each year of added cultivation of the same bulbs.

On the other hand, if the hypothetical grower proceeds on the basis of artificial propagation he can propagate 3,000 or 4,000 bulbs, getting them on the market in about the same time as his small natural propagation, and he can sell the rest of his stock in prime condition. This is not all. The 3,000 or 4,000 propagated bulbs can be grown on but little more than one-fortieth of an acre the first year, not more than one-fifth of an acre the second, half an acre the third, and 1 acre the fourth. The result is so obviously in favor of artificial propagation that there can be no question about its advantage.

Stocks of these bulbs should be grown in as short a time as possible, not only because of the lessened expense but on account of losses which occur with each additional year's handling and the constantly increasing danger of contamination, deterioration, and injury as the bulbs age. With the tendency to adopt extensive methods of culture it is doubtful whether the loss in number through one season of handling can be kept much below 5 per cent through missed, cut, and otherwise injured bulbs. For, be it remembered, the grower starts with a definite number of bulbs in a progeny, which can not be augmented, but it is reduced each year by the losses incident to culture.

SEED PROPAGATION

The common garden hyacinth is a good seed producer, and the seed germinates readily when planted under conditions suitable for the growth of ordinary garden vegetables. Seed sown in late August or early September on Puget Sound has germinated readily the following spring when planted in the open ground 1 to 1½ inches deep. It has been the practice to sow 50 to 100 seeds to a 3-foot row and to have the rows 3 inches apart. The seedlings need two years' growth before they are large enough to be handled.

Culture by this method, of course, gives mixed stocks, and it is by this means that new varieties are produced. It is therefore important, and work of this nature will have to be done before expectations can be fully realized in the production of these stocks. The subject will not be discussed here because no work has been done further than to demonstrate that it is an easy matter to produce seed and that it germinates readily in the spring from September plantings on Puget Sound.

THE MATURITY OF A PROGENY

It is not to be understood that in any propagation the bulbs at the end of a definite time are all of one size. Far from it. Even in the scooped progeny the fifth year the percentage of toppers or exhibition bulbs may be small. There will be more of the first size, a greater number of seconds, and many miniatures.

The maturity of a hyacinth bulb is difficult to define if an attempt is made to express it in a definite term of years' growth, or even to establish it on size. Some of the bulbs in a scored progeny are large enough to be marketed as miniatures the second year if well grown, and the third year they may reach the first and second sizes. On the other hand, the largest bulbs may not begin to split before the sixth year, and most of the progeny may continue to increase in size up to the seventh year before they begin the natural process of division. If planted under conditions of poor fertility, or on firm, hard soil that tends to bake, they may grow even longer without dividing.

The hyacinth bulb enters the market in various sizes from 13 cm. up, and will begin to blossom with a few but quite normal florets when about 8 cm. in circumference. The florets will increase annually as the bulbs develop in size, until the maximum of the big exhibition truss is obtained from a bulb 20 cm. up.

It is difficult to define the state of maturity. Possibly the best criterion is the arrival at maximum size for the variety. When grown another year the bulb splits, but this is of no consequence, for the bulbs are useful during a period of three or four years.

BEDS AND BORDERS

The value of the hyacinth consists as much in its formality as in its intrinsic beauty. It is therefore preeminently adapted to formal bedding, and for this purpose the second and even the third sizes are most commonly used, although the first gives larger trusses and makes a finer exhibition.

The bulbs flower when rather small, but the smaller the size the fewer the number of bells to a spike, and often the more graceful and less formal. It is therefore possible to get a variety of effects from a planting, dependent upon the size of the bulbs used and the number and arrangement in the bed.

The largest bulbs are commonly set 8 to 10 inches apart each way, and the smaller sizes proportionately closer. They are covered with about 4 inches of soil and should receive about the same protection and treatment as described under field handling (p. 5).

In the border the bulbs are usually scattered about singly or in small groups. How long they will function in the permanent border will depend on a variety of factors, chief of which may be the size and age of the bulb planted, the suitability of the location, and the treatment of the border during the dormant season. The younger and smaller the bulbs planted, the longer before they begin to split; the better the drainage and other growing conditions, the less likely the bulbs are to deteriorate during the dormant season. The growing of other plants in the border during the summer is no detriment; indeed, it may actually be a benefit to the bulbs. If much manure is used, rotting of the bulbs may be induced.

The hyacinth is so adaptable that little difficulty is experienced in handling it in beds and borders, and the bulbs seldom need to be sacrificed from such handling. Usually they may be left undug even when bedding plants are used in the summer. Under such circumstances the bulbs, if properly fertilized, need be no worse for their year of service in furnishing ornament in the beds and borders. Bedding plants may be put in between the bulbs soon after the latter have flowered. They may be allowed to take root and grow for a month or more before the bulbs are dug. The digging can then take place, preferably at maturity, but the bulbs can be saved even if lifted three or four weeks before the tops die, and unless they are old they will blossom again the next season, possibly with not so many bells but still satisfactorily. With care and an effort to let the bulbs develop as much as possible before digging they will function until they begin to divide. After this the spikes of the flowers will be more numerous and may be quite small until the daughter bulbs grow up again to good flowering size after one to three years, depending on the handling. The bulbs need not be discarded even when they split badly. The best of the splits will give a little blossom and become more profuse in the number of bells from year to year as they increase in size until full maturity is reached, when they will split again.

HYACINTHS IN THE GREENHOUSE

Less discussion of hyacinth forcing is necessary than its importance indicates, for of all the aspects of hyacinth culture this is best understood and most satisfactorily practiced. The average greenhouse operator has had so much experience that the handling of the stocks is a matter of routine which, for the most part, is performed perfunctorily and almost always successfully. (Fig. 15.)

The bulbs are potted as soon as they arrive in September, then given about eight weeks to root in the heeling ground, being gradually inured to light and heat and for the most part brought into flower in January. The soil is usually a compost and should be one through which water passes freely.

Normal imported stocks are seldom brought into flower before the latter half of January, and it is more often February before they are brought in. Bulbs produced in Virginia are a little earlier. (Fig. 16.) It may be advantageous to pot Virginia bulbs the last of August, and the early ones like L'Innocence may be brought into flower, but with difficulty, by Christmas or New Year's.

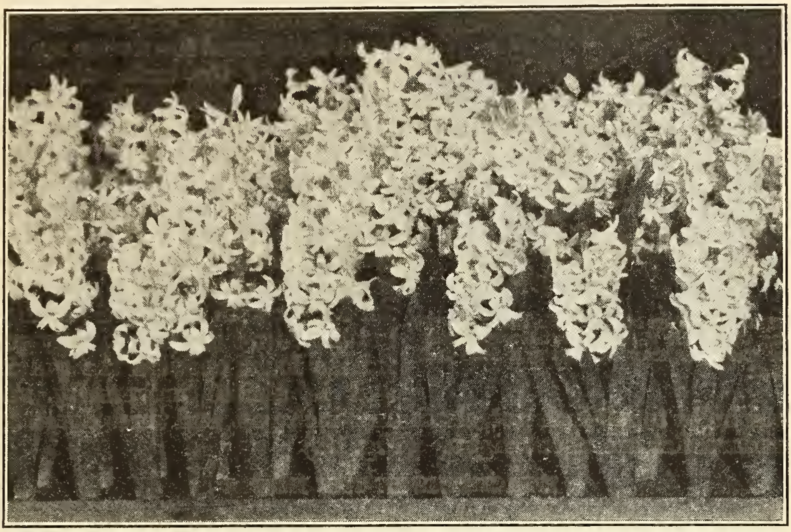

FIGURE 15.—Hyacinth L'Innocence. Grown at Arlington Experiment Farm, Rosslyn, Va., and forced in the United States Department of Agriculture greenhouses

When the bulbs are potted as early as August, fully 12 weeks should be allowed in the heeling ground. Root action is much slower early in the season. The later the bulbs are potted, the shorter the time necessary for them to root and to flower. While it may take three months following late August to root the bulbs properly (fig. 17), they may often be potted and brought into flower in 40 to 50 days after December 1 if held in good storage until that time.

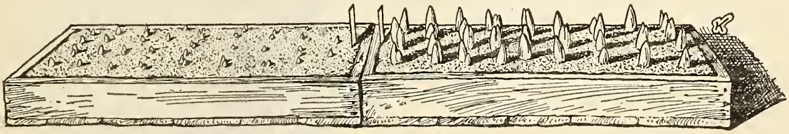

FIGURE 16.—Flats of Hyacinth L'Innocence as removed from the heeling ground to be forced: Left, grown at Bellingham; right, grown at Arlington Experiment Farm

Temperatures for the different stages of forcing are also variable, and few authorities agree exactly, although there is a general agreement. Usually 40° F. is recommended for rooting, 45° to 50° F. for development of tops, and 55° F. for flowering. So far as experience at the Arlington Experiment Farm goes, a temperature of 50°

F. is better for rooting, and 60° F. is none too high for flowering. Late in the season 65° or even 70° F. is safe.

The hackneyed but at the same time logical and sound advice is to see that the plants are well rooted before being subjected to heat, not forced too hard, and given plenty of air. If the pots are full of roots before being brought into the house and the plants are then held under the benches in subdued light until the flower spike is well out of the bulb, success in forcing is practically assured. After that the stocks will stand 60° to 65° or even 70° F. night temperature on the benches.

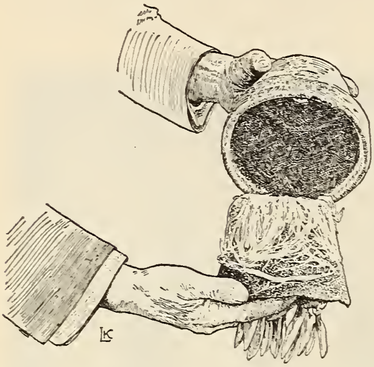

FIGURE 17.—Pan of hyacinth bulbs, showing the right kind of root development at the time they are brought into full heat

In greenhouse culture the bulbs are planted in pots (fig. 18), flats, or solid benches in any good loam soil, preferably of sod, and composted for a year with sand and fertilizer, but this is not necessary. Any good friable loam answers the purpose and is almost universally used. Four bulbs to a 6-inch pot, six to an 8-inch pan, and three dozen to a standard flat are about right. (Fig. 19.)

HYACINTHS IN THE HOUSE

There are few bulbs with which success is so universal under dwelling-house conditions as the hyacinth. If sound stocks are obtained, it is the rare individual who is able to so mistreat the bulbs as to prevent them from flowering. Next to Paperwhite Grandiflora narcissus, the hyacinth is the most nearly foolproof, and in nearly every case it gives a flower if it is planted with anything like reasonable care. There are, however, certain precautions that must be taken to insure success.

Flowers of the hyacinth may be enjoyed in the home from late December until the close of the out-of-door blossoming season if one gets the Dutch prepared or Dutch Roman for the early flowering.

FIGURE 18.—Hyacinth Queen of the Blues. Grown at the Bellingham Bulb Station, Bellingham, Wash., and forced at the Arlington Experiment Farm, Rosslyn, Va.

The early-flowering batches from any of the above categories should be potted in late August if possible and plunged deeply in a moist, shady place where they will remain as cool as possible for two or three months. As soon as the pots are full of roots and the top growth is 1 to 3 or 4 inches high they can be moved into subdued light in a cool cellar or similar location until the greening process is well under way, when they can be put in the cooler portion of the living room in full light. An east window is ideal in most localities. If there happens to be a long spell of mostly cloudy weather, a south window may be better for a time. Care should be taken that the temperature does not go too high. The ideal temperature may be considered as 40° to 50° F. for rooting, 50° to 55° F. for leaf growth, and 55° to 60° or 65° F. for flowering. It is manifestly impossible to realize the first of these temperatures in August in most sections of the eastern United States, and this is a potent source of failure in commercial as well as home flowering of bulbs. The closer one holds to these temperatures, the better his success is likely to be.

Successive batches of bulbs can be potted two to four weeks apart as late as December or even January and flowered successfully if the bulbs are properly stored. The later batches will not need so long a time to root to be brought into flower as the earlier ones, but in all cases they should be kept cool until the pots are full of roots. (Fig. 17.) It is just as well to pot all the bulbs early in the season and govern the time of flowering by the time they are brought indoors.

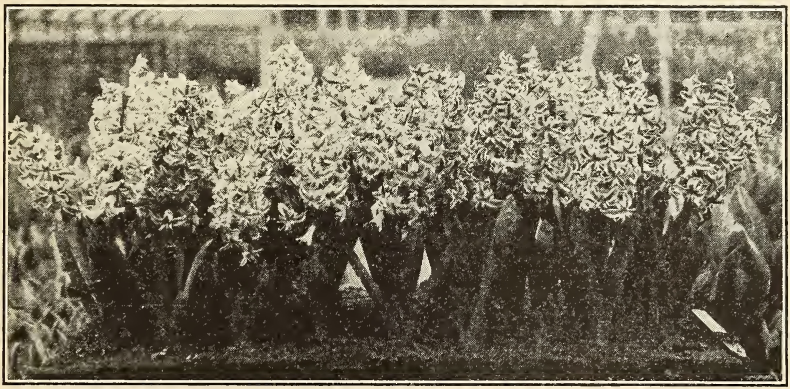

FIGURE 19.—Hyacinth Grand Maitre. Grown and forced at the Arlington Experiment Farm, Rosslyn, Va.

In house culture by far the most common medium for growing hyacinth bulbs is good garden soil. If the soil is heavy, the incorporation of sand and leaf mold or almost any organic débris, to insure a quick percolation for water, will be advisable, although it may not be absolutely necessary. Four to six bulbs, depending on their size, sunk to their necks in a 6 to 7 inch pot or pan, comprise the usual unit. If the largest sized bulbs are used, one bulb in a 4-inch pot has some advantage in that the arrangement obviates the disadvantage of a possible lag in one or more in a pot or pan of five or six bulbs. The florists overcome this unevenness by growing the bulbs in flats and then assembling the plants in pots or pans after they come into full bud. The unevenness is always less late in the season.

Hyacinths in the home are often flowered in water with no soil whatever. At times they are potted in shallow vases wherein the bulbs are held in place by pebbles, washed coarse sand, or even suitable-sized pieces of coal. At other times the bulbs are put singly into specially designed vases with flaring tops. In either case it is better to arrange the bulbs so that the water just barely touches their bottoms; otherwise rotting may occur. In either of these methods of culture it is desirable to incorporate into the water a few lumps of charcoal and a little pulverized oyster shell, or some other source of lime. The water, whether in shallow or deep vases, should be changed weekly.

Various other media in which the bulbs may be grown are often described in floral magazines, seedsmen's catalogues, and in more pretentious treatises on the subject. Coconut fiber, sphagnum moss, and fibrous peat are the most common substances, and even sponges are sometimes employed. Often dealers advertise prepared fiber in which the bulbs are packed in the bowls. All that is then necessary is to add water and put the bulbs away to root. When the culture is in fiber, a good plan is to fill the bowl with water and then invert it over the hand, allowing all the water that will drain out to do so.

In whatever way the householder decides to grow hyacinth bulbs it is advisable that the rooting should take place in a cool, dark place, that the plants be inured to the light gradually, still being kept cool, and that the temperature be kept below 65° F. for best results. The best advice that the householder can follow is: Do not be in a hurry.

Very often a careful selection of the vases and pots in which the bulbs are grown will add to the attractiveness of the floral display. The common burned clay pot of the florist is not particularly attractive, although it is a good receptacle for culture. Decorated pots are made which sometimes have a decided advantage and can be substituted for the ordinary porous ones when the plants come into flower. A tall glass vase in which every movement of the roots can be followed is positively fascinating during the entire period of culture. These accessories appeal to some and have decorative value; but a common tin can with nail holes punched in the bottom grows just as good flowers, and its ugliness can be hidden by a piece of crêpe paper.

The individual's good judgment and taste can add many features to make attractive the growing of hyacinths in the house. The selection of colors, the use of attractive vessels, the covering of the unsightly porous pots, and the sowing of various seeds which will come along and cover the soil, fiber, or other media with a carpet of green by the time the plants are in blossom are suggestive of some of the things that may be done to bring the surroundings into harmony with the inherent beauty of the hyacinth in blossom.

NATURALIZING

The hyacinth is not usually considered a subject for naturalizing, and its employment for this purpose is seldom advised. Under most garden conditions the bulbs split up into a half dozen or more after they reach maturity, and the daughter bulbs thus formed become so crowded that in competition with other vegetation they do not get a chance to grow. If large bulbs are used, this sort of treatment commonly results in diminution of the flower spike the second year and little but grass thereafter.

There are conditions, however, wherein the bulbs seem to function for many years in competition with grasses and low herbs. The writer has had such hardy varieties as L'Innocence, Grand Maitre, Marie, and Gertrude blossom regularly and quite satisfactorily with moderate-sized spikes for 7 or 8 years, and some of them are still satisfactory after 10 years. The bulbs planted were miniatures, about 12 cm. in circumference, and have increased in size very slowly. The conditions of this culture have been very unfavorable from the standpoint of good plant growth. The location has been on a well-drained dry slope upon which bluegrass has a hard time to exist during the summer, giving place to crabgrass after July. This soil is a heavy refractory clay quite devoid of humus. Deep planting under these conditions has produced the results indicated.

In some portions of the country old varieties that seem much better adapted to this sort of treatment than the commercial sorts of the present time are established in old gardens. Some of these also appear to split rather differently (as shown in the so-called Tennessee native), and consequently are better adapted for naturalizing.

MINIATURES, DUTCH ROMAN, CYNTHELLA, AND PREPARED STOCKS

There has been considerable lack of uniformity in the application of terms to designate the different categories of hyacinths. This has been due in large measure to the feared psychological effect of the word "miniature," which relates simply to the size of the bulbs and has no relation to the character of the blossoms, which are nearly if not quite the same in the small sizes as in the exhibition hyacinths. The term "miniature" refers to hyacinth bulbs below full size. They usually range from 13 to 15 cm. in circumference and are advertised for growing in pots and pans, and for bedding. On account of the effect of the term an attempt was made to substitute the coined word "Cynthella," which is used to some extent, but the majority of the lists published have gone back to the use of miniature. The two terms are synonymous.

Not so long ago Dutch growers sent hyacinth bulbs to southern France to be grown one year in order to obtain the advantage of the early season. Bulbs grown there one year could be brought into blossom the next year about two weeks earlier than those in the Netherlands. These were grown in the same region and under the same conditions as the popular Roman hyacinth, with which in a measure they competed. The name under which these were sold was Dutch Roman.

This term is often carried over to apply to an entirely different category, the "prepared bulbs." These constitute a comparatively recent innovation to accomplish the same purpose as growing a season in a climate where the bulbs mature early and therefore force early. Stock of any size may be prepared; consequently, there may be obtained for early forcing not only miniatures but full-sized bulbs as well.

There is considerable mystery about the details of the processes used in the preparation of bulbs for early forcing. The principles involved, however, are rather well known. It is said that the individual growers guard closely the methods used. The principle involved consists in forcing the development of the flower spike, which always takes place in storage in the first few weeks after digging, instead of waiting two or three months for it to grow normally. In the first place the bulbs are dug early, a month or more before the tops die naturally. After drying slightly they are submitted to a high heat, 70° to 90° F., for a period of 10 to 15 days. Published accounts vary from one to six weeks. This is an important point to be determined for our conditions. It is quite possible that formulas used in a foreign land may not exactly apply in this country. The duration and the time of the treatment are important, for treatment too long continued or applied too late in the season has a tendency to retard rather than to advance the forcing quality.

Closely associated with the treatment of hyacinth bulbs for early forcing is the treatment of planting stock similarly late in the season so that it may escape the vicissitudes of bad weather in the spring and in order to prolong the growing season.

The whole subject of treatment for the purpose of influencing the precocity of development is one about which we have little knowledge or experience in this country. Some work has been done on the matter, but not enough to arrive at definite conclusions. The object here is to call attention to the problem, and the work done will serve as a basis for future investigations.

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April 1, 1930

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